Using 8310 & ADAM-4024 4-20mA Output Module

Application Notes

May 2014

1 Overview

This Application note will provide the necessary information to connect an ADAM-4024 4-20mA output module to an 8310 data logger's RS485 port and scale four inputs into four 4-20mA outputs. A wiring diagram is included in Appendix A.

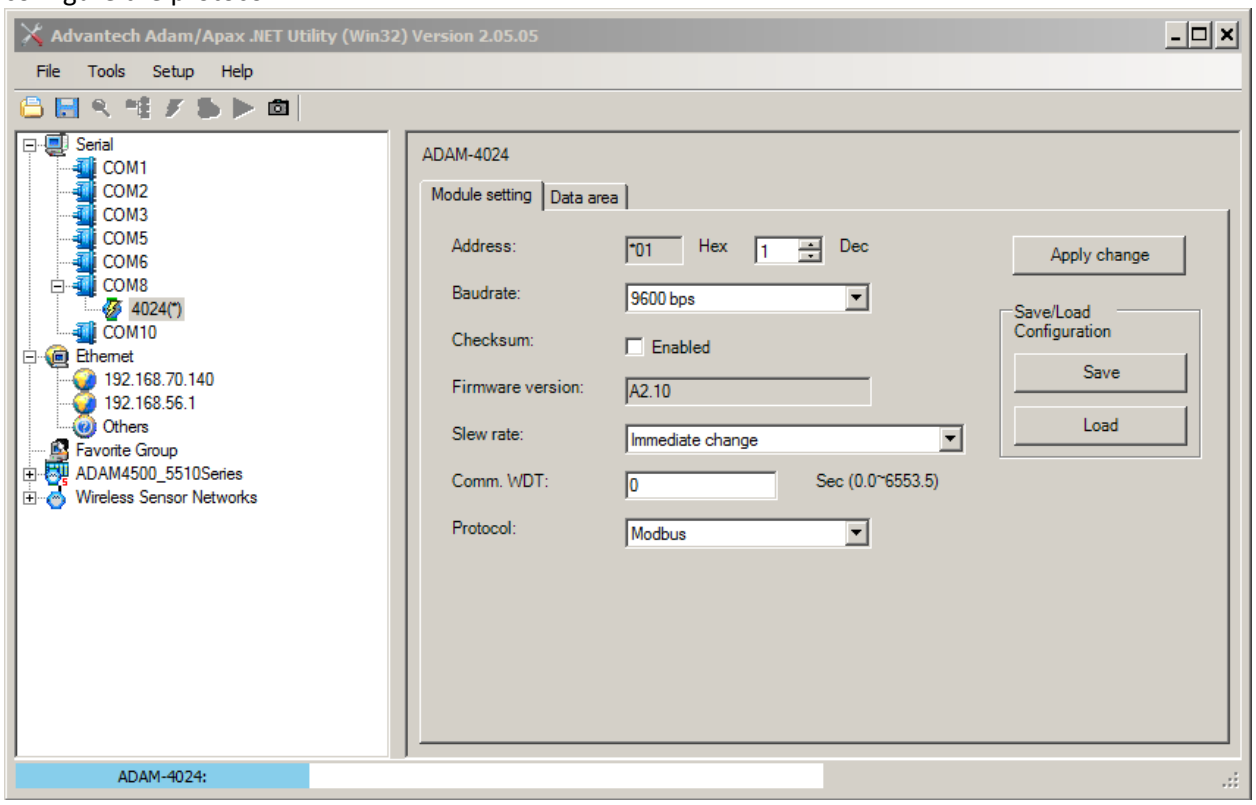
2 Items needed:

- PC with RS-485 to USB converter (Recommended model: Gearmo GM-482422)
- ADAM 4000 User Manual
- Advantech Adm/Apax .NET Utility
- 10-15 Volt Supply
- 8310 Data Logger
- Adam-4024 Modbus to 4-20mA output module

3 Configuring the ADAM-4024

The ADAM-4024 must be configured for RS-485 communications, the factory defaults are to communicate in ADAM ASCII protocol.

1. Use the ADAM-4000 utility (latest ADAM-4000 utility can be found at www.advantech.com) to configure the protocol.



2. With the module powered off, turn the switch in the “Init” position, then power up the module
3. Wait 10 seconds for the module to initialize.
4. Identify the port used by the RS-485 – usb converter. The easiest way to do this is with the utility, start by right clicking on the serial branch and selecting "refresh Nodes". Note the listed ports, then connect the RS-485 converter and repeat the refresh to see what port was added.
5. Connect the RS-485 convert to the ADAM-4024 per wiring diagram in Appendix A.
6. Using the ADAM-4000 utility, right click the appropriate serial com port noted above and search (scan) for the module. (Initial COM settings: 9600 baud, N-8-1)
7. Change the protocol to Modbus, optionally change the address and baud rate (this app note uses the default Address 1 and 9600 baud).
8. Click "Apply Changes"
9. Power off the module.
10. Turn the switch back to NORMAL* position.
11. The module can now be connected to the 8310

4 8310 Setup

The 8310 MBOut block will be used to write the registers to the ADAM-4024 to generate the current output. The 8310 will always use the Modbus op code to write multiple registers, even if it is only writing one. While most Modbus slaves will accept this, the ADAM-4024 will not, so we must actually write to all four registers in one write.

A simple description of how to set up the 8310 is to have four measurements (the sensors to be converted to a current output), four measurements to scale and assign the sensor data to a local Modbus register, and a single measurement to write the local registers (four scaled measurements) to the ADAM-4024.

This example will use a Sutron Accubar CF Bubbler, using the M1 command to retrieve Level (in PSI), temperature, battery voltage and battery voltage under load.

5 Communications

The 8310 must first have a communications port defined where the ADAM-4024 will be connected via Modbus. Here, we want the RS-485, which is only available through the optional terminal block Com 4 by setting the RS485 parameter to yes,

```
          Communications (5)
COM1: (Standby-On)                    DIRECT
COM2:                              NO CONNECT
COM3:                              NO CONNECT
COM4: (Started)                        MODBUS
LAN (Disabled-On)
MODBUSTCP (Disabled)
End Communications

                 MODBUS COM4
Slave                                      No
BaudRate                                 9600
Parity                                   None
Protocol                                  RTU
RTSPreDataMS                               10
RTSPostDataMS                               0
WaitForDSR                                 No
WaitForCTS                                 No
RS485                                     Yes
End MODBUS Menu
```

6 Measurements

An overview of the measurements setup.

```
                Measurements (9)
M1: Stage                    Next: --:--:--
M2: AT                       Next: --:--:--
M3: BV                       Next: --:--:--
M4: BVLOAD                   Next: --:--:--
M5: StageOut                 Next: --:--:--
M6: ATOut                    Next: --:--:--
M7: BVOut                    Next: --:--:--
M8: BVLOADOut                Next: --:--:--
M9: ADAMOUT                  Next: --:--:--
Add Measurement
Delete Measurement
Copy Measurement
Move Measurement
End Measurements
```

Sensors

Here, the four parameters returned from the CF Bubbler are read using measurements 1 through 4. For stage, the PSI to water level in feet conversion is done in measurement 1 via a slope of 2.3067. The rest of the measurements are left as scaled from the CF Bubbler.

```
                    M1: Stage
M1: MeasName                              Stage
Enable                                      Yes
MeasType                           Instantaneous
Interval                                 00:15:00
Time                                     00:00:00
InputType                                   SDI
SDIAddress                                    0
SDICommand                                   M1
SDIParam                                      1
Mux                                        None
SwitchedPwr                                None
Processing                        Slope-Offset
Slope                                   2.3067
Offset                                        0
Cal Slope                                     1
Cal Offset                                    0
Cur Val                                   0 G
M1.O1: Stage                          0.000 G
Simulate
End M1: Stage
```

```
                    M2: AT
M2: MeasName                                AT
Enable                                     Yes
MeasType                         Instantaneous
Interval                              00:15:00
Time                                  00:00:00
InputType                                  SDI
SDIAddress                                   0
SDICommand                                  M1
SDIParam                                     2
Mux                                       None
SwitchedPwr                               None
Processing                                None
Cal Slope                                    1
Cal Offset                                   0
Cur Val                                24.88 G
M2.O1: AT                              24.88 G
Simulate
End M2: AT


                    M3: BV
M3: MeasName                                BV
Enable                                     Yes
MeasType                         Instantaneous
Interval                              00:15:00
Time                                  00:00:00
InputType                                  SDI
SDIAddress                                   0
SDICommand                                  M1
SDIParam                                     3
Mux                                       None
SwitchedPwr                               None
Processing                                None
Cal Slope                                    1
Cal Offset                                   0
Cur Val                                  0 U
M3.O1: BV                              12.00 G
Simulate
End M3: BV
```

```
                    M4: BVLOAD
M4: MeasName                              BVLOAD
Enable                                       Yes
MeasType                             Instantaneous
Interval                                  00:15:00
Time                                      00:00:00
InputType                                    SDI
SDIAddress                                     0
SDICommand                                    M1
SDIParam                                       4
Mux                                         None
SwitchedPwr                                 None
Processing                                   None
Cal Slope                                       1
Cal Offset                                      0
Cur Val                                     0 U
M4.01: BVLOAD                          11.00 G
Simulate
End M4: BVLOAD
```

Local Modbus Registers

These next four measurements are used to define the local Modbus registers and scale them from user units into the appropriate 4-20mA reading. The ADAM-4024 uses a scale of 0 - 4094 to represent the 4 - 20mA output, for a resolution of about 0.004mA.

To calculate the slope and offset needed, use the following formula:

Slope = (Max Output - Min Output) / (Max Reading - Min Reading)
Offset = Min Output - (Min Reading * Slope)
*Where Max Output is 4094, Min Output is 0 and Max and Min Reading are the expected range of values for the sensor.

For a Stage reading of 0 – 20 feet of water:

Slope = (4094 – 0) / (20 – 0)	Offset = 0 – (0 * 204.7)
Slope = 204.7	Offset = 0

For a Temperature reading of -5 – 40 C:

Slope = (4094 – 0) / (40 – -5)	Offset = 0 – (-5 * 90.97778)
Slope = 90.97778	Offset = 454.8889

For a Battery reading of 10 – 16 Volts (used for both standard and battery under load readings):

Slope = (4094 – 0) / (16 – 10)	Offset = 0 – (10 * 682.33)
Slope = 682.33	Offset = -6823.33

In this example, the local Modbus register selected were 201-204, type is Holding Register, Value Type is ushort and min and max are defaults so the sensor does no extra scaling at 0 and 65535.

```
                    M5: StageOut
M5: MeasName                            StageOut
Enable                                       Yes
MeasType                           Instantaneous
Interval                                00:15:00
Time                                    00:00:00
InputType                              Reference
Reference                          M1.O1: Stage
Mux                                         None
SwitchedPwr                                 None
Processing                          Slope-Offset
Slope                                      204.7
Offset                                       0.0
Cal Slope                                      1
Cal Offset                                     0
Cur Val                                3710.188 G
M5.O1: StageOut                        3710.19 G
Simulate
End M5: StageOut

              M5.O1: StageOut/MODBUS
BaseRegister                                 201
Type                          Holding Register
ValueType                                  ushort
Min                                             0
Max                                         65535
LiveReading                                    No
End MODBUS
```

```
                    M6: ATOut
M6: MeasName                                ATOut
Enable                                        Yes
MeasType                               Instantaneous
Interval                                    00:15:00
Time                                        00:00:00
InputType                                 Reference
Reference                                 M2.O1: AT
Mux                                           None
SwitchedPwr                                   None
Processing                             Slope-Offset
Slope                                       90.97778
Offset                                      454.8889
Cal Slope                                          1
Cal Offset                                         0
Cur Val                                   255.88 G
M6.O1: ATOut                              255.88 G
Simulate
End M6: ATOut

                M6.O1: ATOut /MODBUS
BaseRegister                                     202
Type                                Holding Register
ValueType                                      ushort
Min                                                0
Max                                            65535
LiveReading                                       No
End MODBUS
```

M7: BVOut

M7: MeasName	BVOut
Enable	Yes
MeasType	Instantaneous
Interval	00:15:00
Time	00:00:00
InputType	Reference
Reference	M3.O1: BV
Mux	None
SwitchedPwr	None
Processing	Slope-Offset
Slope	682.33
Offset	-6823.33
Cal Slope	1
Cal Offset	0
Cur Val	2047.00 G
M7.O1: BVOut	2047.00 G

Simulate
End M7: BVOut

M7.O1: BVOut /MODBUS

BaseRegister	203
Type	Holding Register
ValueType	ushort
Min	0
Max	65535
LiveReading	No

End MODBUS

```
                M8: BVLOADOut
M8: MeasName                          BVLOADOut
Enable                                      Yes
MeasType                           Instantaneous
Interval                                00:15:00
Time                                    00:00:00
InputType                              Reference
Reference                         M4.O1: BVLOAD
Mux                                         None
SwitchedPwr                                 None
Processing                          Slope-Offset
Slope                                     682.33
Offset                                   -6823.33
Cal Slope                                      1
Cal Offset                                     0
Cur Val                                1791.13 G
M8.O1: BVLOADOut                       1791.13 G
Simulate
End M8: BVLOADOut

             M8.O1: BVLOADOut /MODBUS
BaseRegister                                 204
Type                          Holding Register
ValueType                                  ushort
Min                                             0
Max                                         65535
LiveReading                                    No
End MODBUS
```

Write Modbus Registers to ADAM-4024

Finally, this measurement is used to copy the local scaled Modbus register 201-204 to the ADAM-4024 current output registers (holding registers 1 though 4) at DeviceID 1.

```
                M9: ADAMOUT
M9: MeasName                          ADAMOUT
Enable                                    Yes
MeasType                                MBOut
Interval                              00:15:00
Time                                  00:01:00
DeviceID                                     1
TargetRegister                               1
RegisterType                 Holding Register
ExtendedWrite                             Yes
LocalBaseRegister                         201
NumRegisters                                4
MBDeviceType                           Serial
COMPort                                 COM4:
Timeout                                  5000
Retries                                     3
End M9: ADAMOUT
```

Appendix A Wiring

7 RS-485 Converter to ADAM-4024

Power Supply	ADAM-4024	RS-485 to USB (Gearmo specific terminal numbers)
GND	(B) GND 13	GND (Terminal 5)
+V	(R) +VS	
	(Y) DATA +	RS-485+ (Terminal 1)
	(G) DATA -	RS-485- (Terminal 2)

8 8310 to ADAM-4024

8310	ADAM-4024
PROT GND	(B) GND 13
PROT +12V	(R) +VS
COM 4 – GND	(B) GND 13
COM 4 – 485A	(Y) DATA +
COM 4 – 485B	(G) DATA -

9 ADAM-4024 Current Outputs

The ADAM-4024 current outputs are labeled "I OUT", numbered 0-3 (Outputs 1-4) with a + and -.